

## THE VARIATION OF LYMANTRIA MONACHA, L.

By B. J. LEMPKE.

When studying the classical article of Goldschmidt on the genetics of the melanic forms of *Lymantria monacha*, L. (1921, *Zeitschr. indukt. Abst. u. Vererb.-ehre*, 25: 89-163), I was struck by the difference which may exist between the results of the geneticist and the conceptions of the systematist. It sometimes happens that the same hereditary factor manifests its influence in one sex of a species more than in the other. The result is that we see two different phaenotypes which may have received different names. If there is only the question of one factor the solution is easy. As soon as it has been proved that the two forms genetically belong together, we drop the younger of the two names.

Matters become, however, complicated if two or more factors are at work. Such is the case with *Lymantria monacha*, L., where the black markings depend on the action of three different factors which may occur in all possible combinations. Moreover, the male is more strongly blackened by the same factor than the female. The result is a rather large number of different phaenotypes, many of which are found in both sexes. But then they never are genetically identical. Names are, however, given to phaenotypes in the study of variation. It is therefore inevitable that a certain phaenotype of the ♂ of *monacha* is genetically different from the same phaenotype of the ♀. Goldschmidt was no doubt aware of this difficulty, for while he uses a few of the well-known "aberrational" names for some forms of the ♀ (though never correctly owing to inexactness of the text books), he never does so with the ♂. In this sex the phaenotypes are only indicated with the formula of their genetical constitution. With this result a geneticist is satisfied. But the systematist wants to indicate his forms by names. The ideal solution is a combination of the results of both and it is the object of this article to try and attain this.

Goldschmidt's results may be summarized as follows: Factor *B* causes an augmentation of pigment starting from the central lines. Factor *C* is sex-linked, blackens the hindwings and extends the black on the forewings from the central bands and outer margin. Factor *A*, when present alone, intensifies the black markings of the white specimens and, when combined with *B* and (or) *C*, increases their effect. All these factors are dominant to the type. This work is accompanied by three excellent plates with many figures.\* As not every lepidopterist will be able to consult Goldschmidt's publication, I shall cite the figures of the most used text books when they represent one of the phaenotypes discussed. I shall also indicate in what percentage the different forms are present in the Dutch material, so that a comparison with other countries is possible. As a rule the species is far from common in Holland and cases of serious damage are very scarce. The basis of my research was the material of our two most important collections, those of Amsterdam and Leiden.

Though there is, of course, no absolute proof that the phaenotypes I distinguish are identical with Goldschmidt's genotypes, the result is at any rate a logical succession of forms. It will also be seen that not all

phenotypes are genetically known, so that there is still an opportunity for further investigation. The formulae used are those of Goldschmidt.

THE FORMS OF *Lymantria monacha*, L.

1. f. *kusnezovi*, Kolossov, 1928, *Ent. Zeitschr.*, **41**: 481. "Black or grey pigment fails completely. The head, tegulae and thorax are only covered with white hairs. The forewings are in no way distinguished from the hindwings as regards the colour, the scales on them are white with yellowish tint and very feeble addition of grey tints which are scattered without any regularity and which are only visible with tenfold enlargement . . . The rosy tint on the belly is feebly observable."

Described after 1 ♀ from Ekaterinenburg, Ural, Russia. Wholly white specimens are no doubt extremely scarce and are probably only to be expected in the ♀, which is on an average less strongly marked than the ♂. I never saw an example (nor of the three following forms with reduced markings). As specimens without markings or with reduced markings did not occur among the very large material of Goldschmidt, it is clear that these forms depend on factors which were not present in his stocks.

2. f. *gracilis*, Kroulikovsky, 1911, *Revue russe d'Ent.*, **11**: 445, 1911. "Alis anticis totis albis margine externo late nigricante. (♀.) Rarisime in Rossia orientali.

The forewings are absolutely white, but the outer border is adorned with a broad dark border. The body is as with the type; the moth, a ♀, has a very particular "facies."

It is, perhaps, not by chance that these two extreme forms are described from eastern Russia (the *gracilis* ♀ came from the Government of Viatka), for in the Far East the feebly marked ♀ becomes racial (see subsp. *yunnanensis*).

3. f. *lutea*, Auel, 1908, *Zeitschr. wiss. Ins. biol.*, **4**: 39. "A feebly banded specimen which still has small remains of the bands on costa and inner margin of the forewings, the hindwings are still paler than those of the type form, and the pale red colour of the abdomen stretches almost to the thorax."

Described after a ♀ taken near Potsdam in 1907. The form is also mentioned by Auel, 1909, *op. cit.*, **5**: 159. "The pale aberration preceding the type form in which the bands have disappeared in the centre" (that means: the central part of the bands fails). A rather strange name for a white form.

4. f. *obsoleta*, Schultz, 1910, *Ent. Zeitschr.*, **24**: 36. "The dark transverse lines fail in the central part of the forewings, whereas they remain in the basal and outer marginal parts."

Neither locality nor sex stated.

5. f. *monacha*, L., 1758, *Syst. Nat.* 10 ed.: 501. "P. *Bombyx* elinguis, alis deflexis albis atro-undatis, abdominis incisuris sanguineis."

The well-known type form with white forewings which are crossed by blackish sharply-dentated transverse lines. Genetical formula of the ♂, *bb* (cX) (cX); of the ♀, *bb* (cX). If the factor A is also completely

absent (in this case the symbol *aa* is to be added after the two preceding formulae), the transverse lines are thin. This is the most elegant form. It is not figured in any text book. 12% of the Dutch males belong to it, 15% of the females.

Males in which the factor *A* is present as a heterozygote (*Aa*) have thicker transverse lines, but are otherwise typical. (South, pl. 46, fig. 3; Barrett, II, pl. 69, fig. 1; Spuler, pl. 28, fig. 30a.)

Females which are *Aa* or *AA* show the same characteristic, but to a lesser degree, and in the middle of the inner margin a thick, but centrally still white, blotch appears. (South, fig. 5; Barrett, II, pl. 69, fig. 1a.)

7% of the Dutch males, 29% of the females.

[♂♂ which are *AA* show a dark powdering between the central transverse lines. This phaenotype is a trans. ad f. *mediofasciata*, Lpk. Barrett, fig. 1b. 16% of the Dutch males.]

6. f. ♀ **dorsomaculata** nov. Forewings with strong transverse lines (as the *Aa* males of f. *monacha*) and with a completely black spot in the middle of the inner margin.

This phaenotype is only found in the female, and is easily separable. Genetical formula, *Bb* (*cX*). Combined with *AA*, a slight dark powdering is shown between the central lines. 5 and 4% of the Dutch females.

7. f. **mediofasciata** nov. (*nigra*, Freyer, 1833, *N. Beitr.*, 2: 5, pl. 98, fig. 3, ♀, nec fig. 2, ♂). Forewings with complete dark central band.

Genetical formula of the ♂, *Bb* (*cX*) (*cX*); of the ♀, *BB* (*cX*). Combined with *Aa* and *AA*, there is some dark suffusion along costa and (in the ♂) along the outer margin. A well-known phaenotype, often (but wrongly) named *nigra*, Frr.

The same phaenotype, only with somewhat darker hindwing is, however, produced with quite another genotype: ♂, *bb* (*cX*) (*cX*), only the *aa* group (for *AA* see f. *transiens*, No. 12); ♀, *bb* (*cX*), in which *aa* and *AA* cannot with certainty be distinguished. As phaenotypically the difference is not very great and as there are in material of unknown descent even cases of doubt, it will be the best solution to name only one phaenotype (South, fig. 4, fig. 6; Barrett, fig. 1c; Seitz, pl. 20, g, fig. 2). All the figures cited are of the paler type. Dutch males, 6% (pale) and 4% (dark); females, 11% (pale) and 5% (dark).

8. f. *fasciata*, Hannemann, 1916, *Int. Ent. Zeitschr. Guben*, 10: 37. "A form of *L. monacha* with broad dark central band. The specimen has in the middle of the dark band a white ring with black central point."

Type from Sadowa near Berlin. Distinguished from the preceding form by the broadness of the central band. The white ring round the discal spot seems of less importance. I have not seen a specimen of this form. After writing the above I saw 2 ♂♂ in a Dutch collection. They have a broad black band from second to fourth transverse line but are otherwise typical. A very fine form.

9. f. *mediofusca*, Lambillion, 1919, *Rev. Mens. Soc. Ent. Nam.*, p. 38. "Forewings on the upper side with a broad brown irregular band which occupies half the wing; base white with a black point; outer area white with the markings of the type."

Type from Hertogenwald, Belgium. In numbers 8 and 9 the band very probably extends from the second to the fourth transverse line (in No. 7 from the third to the fourth).

10. f. ♂ *intermedia* nov. The whole forewing powdered with grey brown, the black markings normal, but heavy.

This phaenotype only occurs in the ♂ with the genetical constitution *BB (cX) (cX)*. In the *aa* type there are still some remains of the white ground colour which have completely disappeared when *AA* is present. 7% of the Dutch males.

11. f. ♂ *mixta* nov. Forewings typically white with very intensive transverse lines, hindwings melanic.

A special type of the *bb (CX) (cX)* males, "possibly caused by a multiple allelomorph to *(CX)*" (Goldschmidt). The figure of Seitz, pl. 20g, fig. 1, represents this type very well. Rare, only 1½% of the Dutch males.

12. f. *transiens*, Thierry Mieg, 1886, *Le Naturaliste*, 8: 237. "This aberration is a transition between the type and ab. *eremita*. It participates in both forms, the whole of the wings being much darker than in the type and much less than in ab. *eremita*. ♂ and ♀. Northern Europe."

In order to have a definite meaning for this name, I fix it for the form which has the (smaller) black central band of f. *mediofasciata* and a black outer border. It is a well-known phaenotype, though not figured in the text books. The ♂♂ are the *AA* type of *bb (cX) (CX)*, the females are the *aa* type of *Bb (CX)*. 7% of the Dutch males, 5% of the females.

13. f. *nigra*, Freyer, 1833, *Neue Beitr.*, 2: 5, pl. 98, fig. 2, ♂. The original description is of no use.

The figure shows a ♂ of a higher degree of melanism than the preceding form. The forewings have a broad black central band, extending from the antemedial (the second) transverse line to the postmedial one (the fourth), and a black outer border. In *transiens* the central band extends from the discal (third) line to the fourth. The result is that *transiens* is white with two black bands, whereas *nigra* is black with two white bands (basal and submarginal). The form is not to be found among Goldschmidt's figures and must be rare. I have only one ♂ of it.

14. f. *oethiops*, De Sélys, 1857, *Ann. Soc. Ent. Belg.*, 1: 52; *transiens*, Lambillion, 1909, *Rev. Mens. Soc. Ent. Nam.*, p. 10. "Completely black, with the red border of the body hardly visible, and a row of white spots parallel to the outer margin of the forewings."

This phaenotype, which often also shows some traces of white at the base, is especially known in the ♀. In this sex it is the *AA* type of *Bb (CX)*. The hindwings are very dark. In a further grade the white

spots are reduced through black powdering. This is formed by females the formula of which is *BB (CX)*. They are the darkest which are figured by Goldschmidt and also the darkest I have seen in Holland. I never saw completely black females. As there is no sharp distinction I prefer to indicate this phaenotype as "dark *oethiops*."

The form is, however, also found in the ♂, though Goldschmidt neither figures nor mentions it, so that it is impossible to state its genetical formula. It is much rarer here than the ♀: 3% of the Dutch males, 10% of the females (7% lighter, 3% darker).

15. f. ♂ *albibasa* nov. Forewings black with white base.

Only found in the males. Their genetical constitution is *Bb (CX)* (*cX*). 4% of the Dutch ♂♂.

16. f. *eremita*, Hb. [1803-1808], *Samml. Eur. Schm., Bomb.*, fig. 246. Ground colour blackish with clearly visible transverse lines.

The ♂♂ belonging to this phaenotype have the formula *BB (CX)* (*cX*). It is besides the type one of the best known forms of *monacha*. I never saw females of it and they are not among Goldschmidt's figures. But Seitz (pl. 20g, fig. 4) shows an *eremita* of this sex, in which it must be extremely scarce and the genetical constitution of which is unknown.

Figures of *eremita* ♂♂ are given by Mosley (1899, *Nat. Journal*, 8, pl. xxv, fig. 3), by Seitz (*l.c.*, fig. 3) and by Spuler (pl. 28, fig. 30b).

The commonest form of the Dutch males: 20%!

17. f. *atra*, Linstow, 1907, *Entom. Zeitschr.*, 21: 97. "This aberration has unicolorous black forewings without markings, grey-brown hindwings and a black body."

The darkest form, only known in the ♂. Genetical constitution: *Bb (CX)* (*CX*), and *BB (CX)* (*CX*). Figured by Mosley, *l.c.*, fig. 6, under the wrong name of *eremita*. 5% of the Dutch males.

There remain still a few forms which fall outside the preceding series from unicolorous white to unicolorous black.

18. f. *brunnea*, Stipan, 1923, *Ent. Zeitschr.*, 37: 40. "Strikes very particularly by the brown-grey colour of all the wings, body, antennae and legs. The markings of the forewings are indistinct."

Described after a ♀.

19. f. *subfusca*, Schultz, 1910, *Entom. Zeitschr.*, 24: 36. "All that is black with the type form is here yellow-brown, and the abdomen does not possess a red colour but a yellow-brown one."

Described after a ♀ from Winsen in Germany.

20. f. *flaviventer*, Kroulikovsky, 1901, *Rev. Russe d'ent.*, 9: 303 (*flavoabdominalis*, Schultz, 1910, *l.c.*). "The red of the abdomen replaced by yellow. Rare, among the type form."

Up to the present only one subspecies of *monacha* has been described. This makes it necessary to fix the typonominal form of the species. In his original description of 1758 Linné did not state a locality and gave only one reference, viz.:—"Wilks. pap., 19, t. 3, a. and," which refers to *The English Moths and Butterflies* of Benjamin Wilkes. It is there-

fore the English race which constitutes the typonominal one of the species. It is true that three years later, in the second edition of the *Fauna Succica*, Linné cited the species as an inhabitant of Sweden, but even if a type specimen from that country is still present in the famous London collection, it can never be proved that this was already present in 1758. As far as we know at present, the whole of Europe is inhabited by the same subspecies.

From Tse-kou, S.W. of Ta-t sien-lou, Yunnan, was described:

subsp. *yunnanensis*, Colenette, 1933, *Nov. Zool.*, **39**: 23, pl. III, fig. 3. "♀ . . . Forewing whitish; five fuscous patches on the costa at approximately equal distances apart, the first basally, the fifth near the apex; a small fuscous spot in the cell and an angled fuscous streak along the discocellulars; a fuscous patch postmedially on the inner margin; traces of a crenate fuscous subterminal fascia; a series of fuscous interneural terminal spots, continued round the apex and also on to the fringe, which is otherwise whitish. Hindwing pinkish buff; a broad indistinct tawny-olive subterminal fascia; a series of fuscous interneural terminal spots, continued on to the fringe, which is otherwise pinkish buff. *Underside* of both wings, and fringes, tawny olive, marked indistinctly as on upperside; on the hindwing a fuscous discocellular spot and an indistinct postmedial fascia.

♂. Very similar to Swiss specimens of *L. monacha monacha*, the markings on the forewing fine but distinct, the dark terminal band on the hindwing merging without a definite boundary into the ground colour."

Gaede (1932, Seitz, *Suppl.* **2**: 102, pl. 8g, fig. 3) mentioned the form (without naming it) as a subsp. of *Lymantria ascetria*, Hb., and figured the ♂, but an examination of the male genitalia by Colenette showed the form to be co-specific with *Lymantria monacha*, L.

The figure in the *Nov. Zool.* shows a female with strongly reduced markings on the forewings: only the dark costal spots, the dark spot in the middle of the inner margin, and the spots on the fringe are present.

In summarizing the results of my article I append a list of all forms of *Lymantria monacha*, L., the genetical constitution of which is known, and using the formulae of Goldschmidt. As all forms are checked with the original descriptions and figures of previous authors, the list may provide a definite basis for further research.

GENOTYPE OF THE ♂.

PHAENOTYPE OF THE ♂.

<i>bb</i> ( <i>cX</i> ) ( <i>cX</i> ) .....	<i>monacha</i> , L.
<i>Bb</i> ( <i>cX</i> ) ( <i>cX</i> ) .....	<i>mediofasciata</i> , Lpk.
<i>BB</i> ( <i>cX</i> ) ( <i>cX</i> ) .....	<i>intermedia</i> , Lpk.
<i>bb</i> ( <i>cX</i> ) ( <i>CX</i> ) <i>aa</i> .....	<i>mediofasciata</i> , Lpk. (darker specimens).
<i>bb</i> ( <i>cX</i> ) ( <i>CX</i> ) <i>AA</i> .....	<i>transiens</i> , Thierry Mieg.
<i>bb</i> ( <i>CX</i> ) ( <i>CX</i> ) .....	"Black specimens, not to be distinguished from other black ones," says Goldschmidt. Not figured by him; presumably <i>atra</i> , Lin-stow.

<i>Bb</i> (cX) (CX) .....	<i>albibasa</i> , Lpk.
<i>BB</i> (cX) (CX) .....	<i>cremita</i> , Hb.
<i>Bb</i> (CX) (CX) .....	<i>atra</i> , Linstow.
<i>BB</i> (CX) (CX) .....	<i>atra</i> , Linstow.

## GENOTYPE OF THE ♀.

## PHAENOTYPE OF THE ♀.

<i>bb</i> (cX) .....	<i>monacha</i> , L.
<i>Bb</i> (cX) .....	<i>dorsomaculata</i> , Lpk.
<i>BB</i> (cX) .....	<i>mediofasciata</i> , Lpk.
<i>bb</i> (CX) .....	<i>mediofasciata</i> , Lpk. (darker specimens).
<i>Bb</i> (CX) <i>aa</i> .....	<i>transiens</i> , Thierry Mieg.
<i>Bb</i> (CX) <i>AA</i> .....	<i>oethiops</i> , De Sélys.
<i>BB</i> (CX) .....	<i>oethiops</i> , De Sélys. (darker specimens).

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## ADDITIONS TO THE LAMPTON LIST OF COLEOPTERA.

By HORACE DONISTHORPE, F.Z.S., F.R.E.S., etc.

In 1945 [*Ent. Record*, 57, pp. 28-29; 40-41 (1945)] I described a patch of waste ground at Lampton, Middlesex, which is within three minutes walk from my house at Heston, and which has proved a most prolific collecting ground for beetles. I may here mention that at one corner of the ground there is a very large boulder which I have loosely described as prehistoric. Last year I took photographs of it, and gave them to the Geological Department of the British Museum (Nat. Hist.). They tell me it is much older than prehistoric, being pre-glacial, and probably Eocene.

The additions to the above list are as follows:—

CARABIDÆ—*Amara plebia*, Gyll., in vegetable refuse.

STAPHYLINIDÆ—*Atheta atramentaria*, Gyll., in vegetable refuse; *A. soror*, Kr., sweeping; *Tachyporus solutus*, Er., sweeping; *Oligota granaria*, Er., and *O. flavicornis*, Lae., beating willows. The former is usually found in granaries, cellars, and the like. *Xantholinus fulgidus*, F., in vegetable refuse.

SILPHIDÆ—*Silpha aevigata*, F., on pavement.

PHALACRIDÆ—*Olibrus millefolii*, Pk., sweeping Yarrow (*Achillea millefolium*).

COCCINELLIDÆ—*Scymnus limbatus*, Steph., a short series taken by beating willows. This is a good and distinct species and not a variety of *S. suturalis*, Thunb., which occurs on fir trees.

HISTERIDÆ—*Onthophilus striatus*, F., in vegetable refuse.

NITULIDÆ—*Meligethes picipes*, Stm., sweeping.

LATHRIDIDÆ—*Melanophthalma distinguenda*, Com., sweeping.

DERMESTIDÆ—*Helocerus claviger*, Er., and *Anthrenus varius*, F., sweeping umbels.

EUCNEMIDÆ—*Throscus carinifrons*, Bonv., sweeping.

TELEPHORIDÆ—*Telephorus bicolor*, F.; *Malachius bipustulatus*, L., ab. *immaculatus*, Rey; and *Malthodes marginatus*, Lat., sweeping.